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a guide to HARDWOOD LOG GRADING

NORTHEASTERN FOREST EXPERIMENT STATION • FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE • UPPER DARBY, PA. • 1963

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Experiment Station under the supervision of M. D. Ostrander. Basically it is a revised edition of C. R. Lockard's mimeographed publication *Manual for Hardwood Log Grading in the Northeast,* which has been revised and reprinted numerous times during the past decade.

The helpful comments and suggestions received from Forest Service log-grade specialists R. D. Carpenter, J. A. Putnam, and C. L. Vaughan are gratefully acknowledged.

a guide to HARDWOOD LOG GRADING

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The Hardwood Timber Resource

OF the 2 trillion board feet of merchantable timber standing on forest lands of the United States, about one-fifth—400 billion board feet—is hardwood. Of the hardwood trees, 99 are commercial species that are used to produce sawed products; and 68 of these same species also produce veneer products.

These commercial hardwood species grow on half of the 485 million acres of commercial forest land in the country; and they produce one-fourth of all the lumber cut. The annual harvest of hardwood trees for lumber and other wood products amounts to about 12.3 billion board feet.

Fabricating this raw material into finished consumer goods is a complex business. In their intrinsic qualities, hardwoods vary greatly both within and between species. Some, like yellow birch, cherry, persimmon, and walnut, have highly desired qualities that put them almost in the class of precious woods. Others, like beech, boxelder, and scarlet oak, have qualities that make them much less desirable, so that they are usually much less in demand. The wide distribution and variety of species, together with these great variations in attributes in and between species, and the intricacies of utilization, create both technical and economic problems in evaluating a species' usability.

Log Grades in General

WHY GRADE LOGS?

A major objective of log-grading is to separate from the woods run of logs those that are suitable for the manufacture of a given product or products (veneer, standard lumber, ties, etc.); and, for each kind or class so separated, to determine the relative qualities of products obtainable from groups of logs with various distinct surface characteristics. Other objectives may be to establish basic log-merchantability specifications, to stratify logs for the purpose of increasing efficiency of sampling for various forestry purposes, or to form the basis for tree grades.

JUDGING LOG GRADES

Some people judge usefulness of a log-grading system by simplicity or ease of application. This is not a sound approach to the problem. Whether or not log grades are suitable for a given objective depends not upon how easy they are to use but upon how well they meet stated performance standards. In the task force report prepared for the Forest Service Log Grade Committee, the objectives and the application of standards are discussed in considerable detail. For example, in the hardwood factory-lumber log grades, the Forest Service standards require that the system must:

1. Separate from woods-run logs those that are logically suited for sawing into standard factory lumber.
2. Segregate such logs into high-, medium-, and low-quality groups (grades) as determined by the lumber-grade yield pattern and gross lumber value they will produce when sawed into lumber in an adequate mill by a sawyer skilled in the production of standard graded hardwood lumber.
3. Provide a substantial differential in average lumber value between the several log grades, and minimize the overlapping

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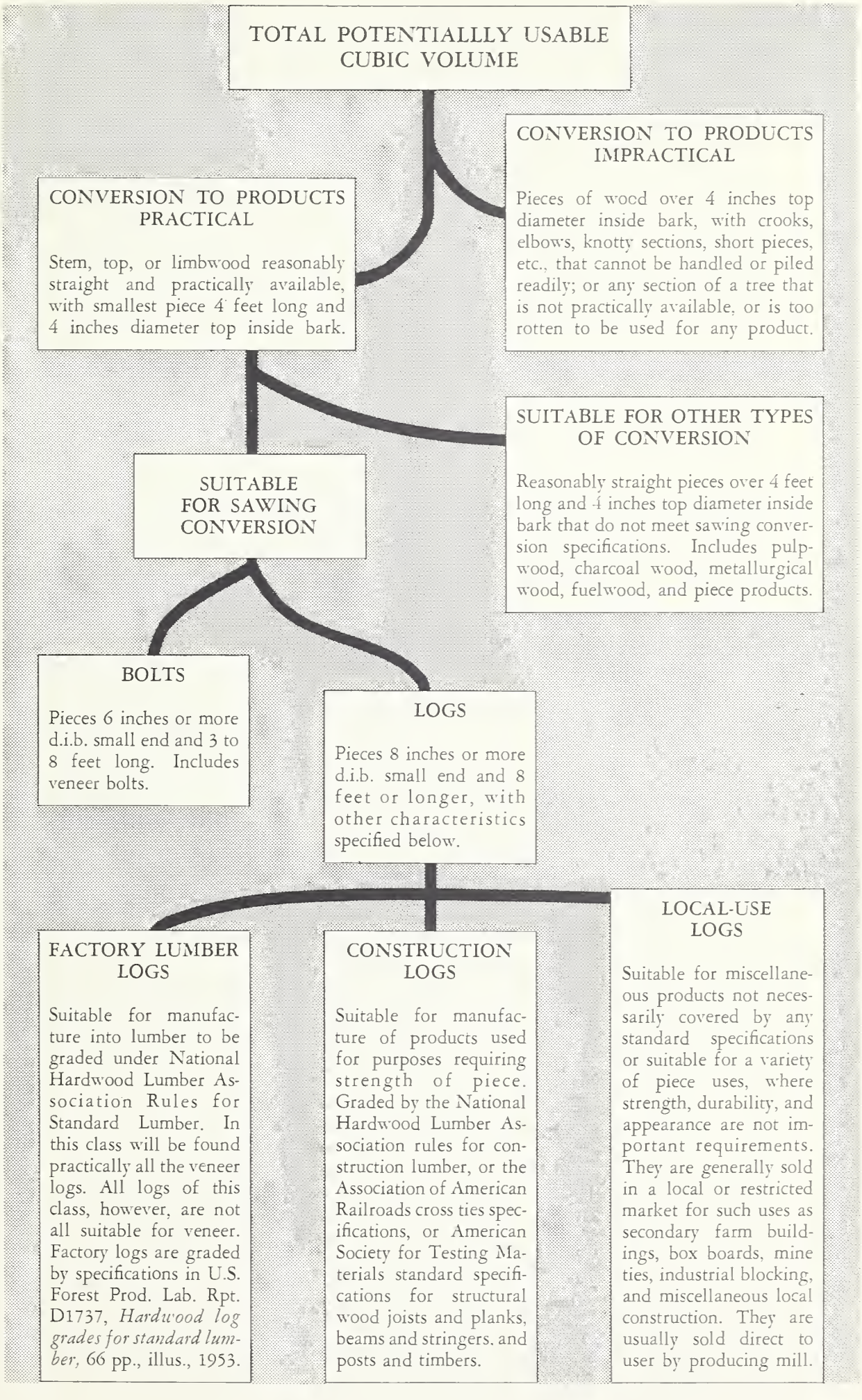
Figure 1.—The possible products obtainable from the total cubic volume in a hardwood tree.


TOTAL POTENTIALLLY USABLE CUBIC VOLUME
CONVERSION TO PRODUCTS IMPRACTICAL
Pieces of wood over 4 inches top diameter inside bark, with crooks, elbows, knotty sections, short pieces, etc., that cannot be handled or piled readily; or any section of a tree that is not practically available, or is too rotten to be used for any product.
CONVERSION TO PRODUCTS PRACTICAL
Stem, top, or limbwood reasonably straight and practically available, with smallest piece 4 feet long and 4 inches diameter top inside bark.
SUITABLE FOR OTHER TYPES OF CONVERSION
Reasonably straight pieces over 4 feet long and 4 inches top diameter inside bark that do not meet sawing conversion specifications. Includes pulpwood, charcoal wood, metallurgical wood, fuelwood, and piece products.
SUITABLE FOR SAWING CONVERSION
BOLTS
Pieces 6 inches or more d.i.b. small end and 3 to 8 feet long. Includes veneer bolts.
LOGS
Pieces 8 inches or more d.i.b. small end and 8 feet or longer, with other characteristics specified below.
FACTORY LUMBER LOGS
Suitable for manufacture into lumber to be graded under National Hardwood Lumber Association Rules for Standard Lumber. In this class will be found practically all the veneer logs. All logs of this class, however, are not all suitable for veneer. Factory logs are graded by specifications in U.S. Forest Prod. Lab. Rpt. D1737, Hardwood log grades for standard lumber, 66 pp., illus., 1953.
CONSTRUCTION LOGS
Suitable for manufacture of products used for purposes requiring strength of piece. Graded by the National Hardwood Lumber Association rules for construction lumber, or the Association of American Railroads cross ties specifications, or American Society for Testing Materials standard specifications for structural wood joists and planks, beams and stringers, and posts and timbers.
LOCAL-USE LOGS
Suitable for miscellaneous products not necessarily covered by any standard specifications or suitable for a variety of piece uses, where strength, durability, and appearance are not important requirements. They are generally sold in a local or restricted market for such uses as secondary farm buildings, box boards, mine ties, industrial blocking, and miscellaneous local construction. They are usually sold direct to user by producing mill.

of values of individual logs in the different grades (as when a low-grade log cuts out better than a log of equal size in a higher grade).

4. Perform with a stated degree of reliability on small quantities of logs (say 25 to 50 logs) as well as on larger quantities.

5. Make use of terms and methods sufficiently simple so that men with a reasonable amount of training and experience can apply them in a practical way to a wide range of forestry activities (timber appraisal, log sale or purchase, production control, research).

POOREST LOG CONCEPT

A specifically defined *poorest log* is basic for any system, even though it is recognized that the specification may vary from time to time with changing economic conditions and probably must always be arbitrary. If material below this arbitrary minimum is economically utilized, this material merely becomes another group of bole segments, usually of minor significance, which can be evaluated separately. When the use does not include everything down to the poorest log, as defined, this can be remedied by raising the minimum to the next higher standard classification.

A practical definition for a standard minimum hardwood log is: Any piece of a tree stem 8 inches or more in diameter and 8 feet or more in length, with sweep not exceeding ½ the diameter of the small end; with not more than ½ to ⅔ the gross volume in scaling defects; and with any number of knots, holes, rotten areas, etc.—provided the diameter of none exceeds ½ the diameter of the log at point of occurrence. A log is generally separated from a bolt by a length specification; bole segments 8 feet or more in length are called logs; those under 8 feet are called bolts. A further breakdown of potentially usable material in a hardwood tree is illustrated in figure 1.

USE CLASSES

The many factors that influence log quality can be isolated and their effect can be gaged only if use is taken into consideration. All hardwood logs of better than the minimum specification are not equally well suited for the production of items for which quality requirements are similar. However, three broad log-use classes seem adequate to cover current hardwood utilization practices. These are as follows:

1. Factory class.—This is a type of log basically adapted to the production of lumber that later will be cut into smaller pieces, these to be free (or relatively free) from blemishes and imperfections. Veneer logs are also included in this log-use class (fig. 1).

The value (grade) of lumber cut from such logs is determined by specifications of the National Hardwood Lumber Association grading rules for standard lumber (fig. 2). These lumber grades specify the minimum yield of defect-free material from each grade. The technical bases for the grading are the so-called clear face and the sound cuttings obtainable. High-grade boards are those that will yield high percentages of clear face cuttings and relatively large individual cuttings. Low-grade boards are those that yield small percentages of clear face and sound cuttings.

2. Construction class.—This class includes logs suitable for sawing into ties and timbers and other items to be used, more or less intact, for structural or weight-bearing purposes. Grade specifications are contained in the construction-lumber section of the National Hardwood Lumber Association rules; the tie specifications of the American Railway Association; and the standard specifications for structural wood joists and planks, beams and stringers, and posts and timbers of the American Society for Testing Materials.

In general, these specifications are designed to insure strength of piece. In the usual run of logs suitable for this use, the position and condition of heart are especially important factors. Knots and other defects that would impair the strength of product are limited to sizes that hold impairment within acceptable limits.

Although factory-lumber grades allow for progressively more defects from the high grades to the low grades, construction specifications are rigid throughout with regard to the inclusion of weakening imperfections. This results in log requirements different from those for factory-lumber use. For example, a factory log with a rotten, shaky interior, and having large but widely spaced individual defects (fig. 7) may produce enough high-grade boards so that a high average quality of yield can be obtained. Yet such a log would be practically worthless as a construction log.

3. Local-use class.—In general, local-use logs are those that are suitable for products not usually covered by any standard specifications. High strength, great durability, or fine appearance are not required in these products. These logs are generally sold in local or restricted markets for use in secondary farm buildings, crating,

BASIC SPECIFICATIONS FOR STANDARD HARDWOOD LUMBER GRADES

Grade	Minimum requirements				
	Length[1] (feet)	Width (inches)	Yield of rough lumber in clear cuttings[2] (percent)	Size of cuttings	Cuttings[3] (number)
Firsts & seconds	8	6	83-1/3	4" × 5' or 3" × 7'	1 to 4
Selects	6	4	Better face is seconds; reverse side of cuttings is sound, or reverse side of piece is 1 Common.		
1 Common	4	3	66-2/3	4" × 2' or 3" × 3'	1 to 5
2 Common	4	3	50	3" × 2'	1 to 7
Sound wormy	Full log yield of 1 Common and better, with worm holes, knots, etc. not over 3/4 inch; stain admitted into cuttings.				
3A Common	4	3	33-1/3	3" × 2'	No limit
3B Common	4	3	[4] 25	$1\frac{1}{2}$" × variable length	To give 36 square inches

[1] Percentage of short lengths is limited by grades; for example, in Firsts only 12 percent can be 8 feet to 9 feet; in 2C, 10 percent can be 4 feet to 5 feet.

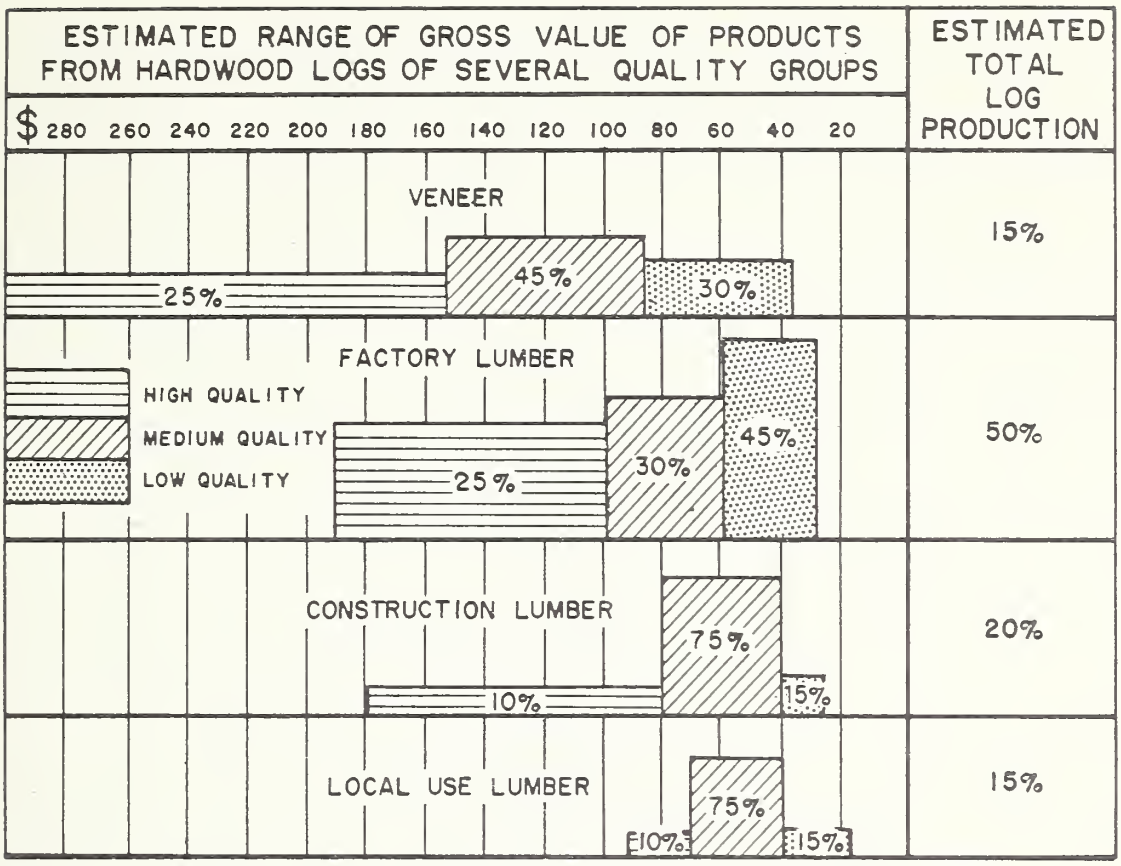
[2] A. Clear face cutting: A cutting having one clear face and the reverse side sound as defined in "sound cuttings". The clear face of the cutting shall be on the poor side of the board except when otherwise specified. Admissible defects: ordinary season checks, unlimited sapwood, mineral streaks and spots, burls, and stain provided it will dress out.

B. Sound cuttings: A cutting free from rot, pith, shake, and wane. It will admit sound knots, sound bird pecks, stain, streaks or their equivalent, season checks not materially impairing the strength of the cutting, pin, shot, and spot worm holes. Other holes 1/2" or larger are admitted but shall be limited as follows: Two 1/4" or one 1/2" in diameter to each 12 units (144 square inches) and on one side of a cutting. Texture is not considered in sound cutting.

[3] Number varies with surface measure of piece; for example, in 1C with surface measure of 5 feet to 7 feet, 2 cuttings are allowed; in 1C with surface measure of 11 feet to 14 feet, 4 cuttings are allowed.

[4] On basis of sound cuttings; lumber is suitable for low-grade crating and dunnage.

Figure 2.—The specifications for standard hardwood lumber grades, adapted from the rule book of the National Hardwood Lumber Association (Chicago, 1961).



NOTE: TOTAL OF VERTICAL BAR DISTANCES EQUALS 100% OF LOG VOLUMES.

RANGE OF PRODUCT VALUES PER M

NORTHEASTERN SPECIES AND VALUES USED

USE CLASS	HIGH-QUALITY LOGS	MEDIUM-QUALITY LOGS	LOW-QUALITY LOGS	ALL LOGS
VENEER	$150 – 300+	$85 – 150	$35 – 85	$100
FACTORY LUMBER	100 – 190	60 – 100	30 – 50	75
CONSTRUCTION LUMBER	80 – 180	40 – 80	30 – 40	65
LOCAL USE	70 – 90	40 – 70	20 – 40	45

Figure 3.—An illustration of the problem of overlap in values between grades in four common use classes of logs.

mine ties, and industrial blocking. Whereas the products of the other two classes are usually sold over a wide area and through a variety of marketing channels, local-use materials are generally sold directly to the user by the producer. This often makes the handling of local-use logs rather profitable.

Within these broad use classes there can, of course, be grades. The specifications for the different classes and for the different grades within the classes will be those required to separate logs accurately and consistently into value groups. In this broad use classification and in the grading within the classes, there is not necessarily any implication of a price relationship between any grade in any class with any grade in any other class. Nor is there

any basic price distinction between classes. The value of the material in the various classes, and of the grades within them, depends entirely upon the objectives of the operator using the system. For example, a mill making construction-lumber items has a value basis entirely different from that of a mill making factory-lumber items. As hardwood businesses are run, the local-use class usually has the least value. Even so, this does not indicate that the logs in this class are necessarily unprofitable.

These questions of comparative values are graphically illustrated on the chart in fig. 3. As this chart shows, a log grader would have great difficulty in picking the right specifications for any log if all utilization possibilities were open to him. But in practice, the grader is not faced with this possibility because under most circumstances he is grading for a specific set of conditions that requires the selection of a grading system that reflects the business situation for which grading is to be the control.

For example, at a standard lumber mill the first grading is on the basis of the factory-lumber class. As mentioned earlier, this will include practically all veneer-class logs. After the grader has selected the logs that meet the specifications for factory grades 1, 2, and 3, (F1, F2, F3) he may find a residual group of logs. Either he does not grade these and considers them merely as sub-grade logs; or he sorts out the logs that will make the next most valuable class, the construction-lumber logs. Any further residue then falls into the class of local-use lumber logs—provided, of course, that they meet the minimum specifications.

This method of grading is a one-way street, for logs not suitable for the first classification may be suitable for a lower class.

OTHER PRODUCTS

So far we have been concerned primarily with large sawed products; and it may seem that inadequate attention has been given to other products such as cooperage, dimension stock, handle stock and specialties. The fact is that, although these items may assume considerable importance locally, they are but a minor part (about 20 percent) in the overall picture of hardwood utilization. Furthermore, specialty-product specifications are related closely to those for factory lumber in that relatively short, clear pieces of practically perfect wood are desired. Limited studies of specialty products have shown that log quality for specialty products can be gaged closely by the factory-log system.

GRADE DEFECTS AND SCALABLE DEFECTS

The Society of American Foresters in its *Forestry Terminology* defines the term *defect* very broadly. Defect is conceived to be "any irregularity or imperfection in a tree, log, piece product, or lumber that reduces the volume of sound wood or lowers its durability, strength, or utility values."

Defects fall into two main categories: (1) those that reduce volume of round wood or lower its durability; and (2) those that lower its strength or otherwise limit its utility. The first comprise *scalable defects* (rot, shake, etc.). The second comprise *grading defects* (knots, stain, etc.).

The term *defective timber* popularly connotes rotten or overmature trees even though the tree may contain much usable material. The amount of scalable defect, together with size limitations, is often the main criterion used to determine merchantability of logs or trees. Actually, logs from which *unusable material* (scalable defect) will be removed in maufacture are not necessarily defective in grading terms, for there may be no serious blemishes (grading defects) in the remaining usable wood.

On the other hand, perfectly sound trees (without scalable defect) may be worthless because of the prevalence of grading defects that cannot be eliminated in manufacture. Since a defect that reduces volume (for example, rot) is different from something that reduces utility (for example, knot), it is logical to call the former *scalable defects* and the latter *grade defects.* The distinction between the two is not always clear-cut. Small volumes of scalable defect may be left in the product, affecting strength or utility or lowering product grade; this becomes a grade defect. Further discussion of this can be found in U. S. Department of Agriculture Handbook No. 4, *Log defects in southern hardwoods,* by Lockard, Putnam, and Carpenter, 1950.

The importance of use class in grading becomes apparent when log defects are considered. In one log class a certain blemish in the wood is a degrader, so the indicator on the log surface is a log defect. In another use class, the same blemish does not degrade the product; so the indicator on the log surface is not a log defect. An example of this is a ¼-inch sound knot. In factory lumber this is a degrading blemish: in construction logs it is not (table 1).

Table 1.—Classification of log surface abnormalities

Abnormalities	Factory logs	Construction logs	Local-use logs
Bulges:			
Butt	(1)	(1)	No defect
Stem	(1)	(1)	No defect
Bumps:			
High	Defect	(2)	(2)
Low	(3)	(3)	(2)
Burl	Defect	Defect	(2)
Butt scar	(1,4)	(1,4)	No defect
Butt swell	No defect	No defect	No defect
Canker	(1)	(1)	No defect
Conk	Defect	Defect	No defect
Epicormic and adventitious			
bud clusters	(2,4)	No defect	No defect
Flanges	No defect	No defect	No defect
Flutes	(4)	(4)	No defect
Fork	(1)	(1)	No defect
Gum lesions	(3)	No defect	No defect
Holes:			
Large	Defect	(5)	(2)
Medium:			
Bark scarrer, fresh	No defect	No defect	No defect
Bark scarrer, old	Defect	No defect	No defect
Birds, light	No defect	No defect	No defect
Birds, heavy	Defect	No defect	No defect
Grub	Defect	No defect	No defect
Increment borer	Defect	No defect	No defect
Tap	Defect	No defect	No defect
Small	(4)	No defect	No defect
Log knots:			
Sound	Defect	(2)	(2)
Unsound	Defect	(5)	(2)
Limbs			
Overgrowths:			
Knots and bark pockets	Defect	(2)	No defect
Insects	Defect	No defect	No defect
Bird peck	Defect	No defect	No defect
Bark distortions	Defect	No defect	No defect
Seams	(4)	(4)	No defect
Splits	(4)	(4)	No defect
Surface rise	No defect	No defect	No defect
Wounds:			
New	No defect	No defect	No defect
Old	(4)	(4)	No defect
Dote	(6)	Defect	No defect
Double pith	(1)	(1)	No defect
Grease spots	(7)	No defect	No defect
Grub channels	(7)	(7)	No defect
Gum spots	(3)	No defect	No defect
Loose heart	(6)	Defect	No defect
Mineral streak and stain	(7)	No defect	No defect
Pin worm holes	Defect	No defect	No defect
Rot	(6)	Defect	No defect
Shake:			
Ring	(6)	Defect	No defect
Wind	(6)	Defect	No defect
Shot worm holes	Defect	No defect	No defect
Soak	(7)	No defect	No defect
Spider heart	(6)	Defect	No defect
Spot or flag worm holes	Defect	No defect	No defect

Key to Class

1. Defect if not cut off.
2. Defect if large.
3. Defect if certain species involved.
4. Defect if not superficial.
5. Defect if large and deep.
6. Defect if not confined to heart center.
7. Defect if concentrated.

FOREST SERVICE STANDARD SPECIFICATIONS[1] FOR HARDWOOD FACTORY LUMBER LOGS

(From U.S. Forest Products Laboratory Report D1737)

Grading Factors		Log grades							
		F1			F2				F3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Diameter, scaling, inches		[2] 13-15	16-19	20+	[3] 11+	12+			8+
Length without trim, feet		10+			10+	8-9	10-11	12+	8+
Clear cuttings[4] on each 3 best faces[5]	Length, min., feet	7	5	3	3	3	3	3	2
	Number, maximum	2	2	2	2	2	2	3	No limit
	Percent of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Sweep allowance (maximum) in percent gross volume	For logs with less than 1/4 of end in sound defects	15%			30%				50%
	For logs with more than 1/4 of end in sound defects	10%			20%				35%
Total scaling deduction[6]		40%			[7] 50%				50%
End defect:		See special instructions (page 21)							

[1] See page 5 for general definition.

[2] Ash and basswood butts can be 12 inches if otherwise meeting requirements for small #1's.

[3] Ten-inch logs of all species can be #2 if otherwise meeting requirements for small #1's.

[4] A clear cutting is a portion of a face free of defects, extending the width of the face.

[5] A face is 1/4 of the surface of the log as divided lengthwise.

[6] Otherwise #1 logs with 41-60% deductions can be #2.

[7] Otherwise #2 logs with 51-60% deductions can be #3.

Figure 4.—Hardwood timber-grading specifications for hardwood factory lumber logs, based on U.S. Forest Products Laboratory studies.

Analysis and Application of Log-Grade Specifications

STANDARD GRADES FOR HARDWOOD FACTORY-LUMBER LOGS

The factory-lumber log class has been divided into three grades. The specifications for these grades (fig. 4) have been closely correlated with the specifications for standard hardwood lumber grades, the grade of the log depending largely on the percentage of log surface that is in clear cuttings of minimum length.

The major factors that affect the quality of factory-lumber logs are: (1) position of log in tree—butt or upper; (2) size of log, especially diameter; (3) straightness; (4) amount and distribution of scalable defect; and (5) imperfections in the usable wood outside the heart center. *Heart center* is used in a restricted sense; it is the wood in a cylinder in the center of the log with a radius equal to one-fifth of the scaling diameter.

In practice, the log is visually squared up and divided into four faces (fig. 5). Each face is evaluated the same way a piece of lumber would be graded, with the exception that rip and sound cuttings are not allowed; all cuttings must be clear and full width of face. The poorest face of the log can be disregarded; the grade

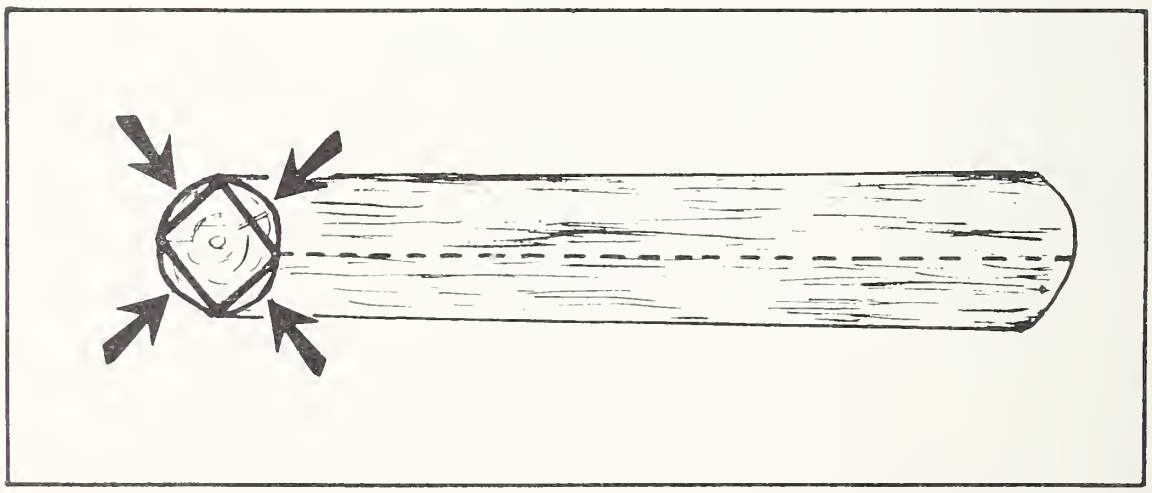
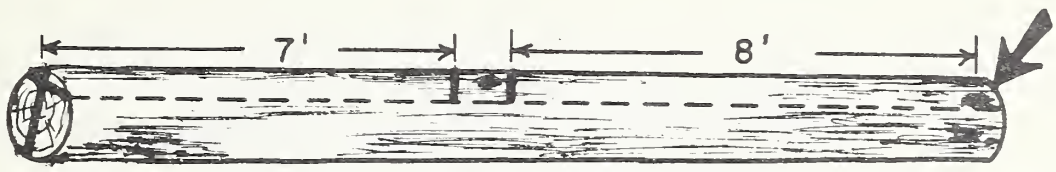
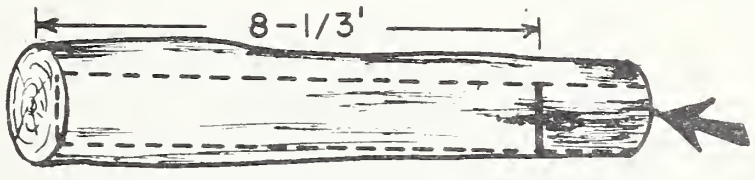


Figure 5.—The grading faces used in grading hardwood sawlogs. Each face is judged as though it were a board.

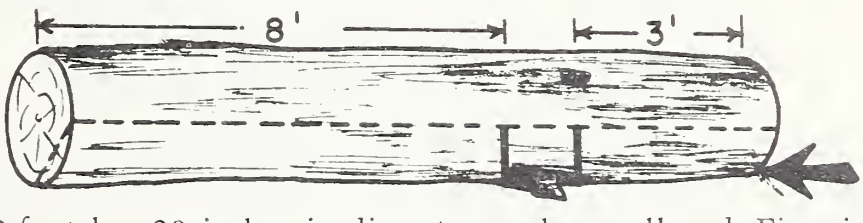
HARDWOOD FACTORY GRADE 1



A 16-foot butt log 13 inches in diameter at the small end. More than 5/6 of its grading-face length is clear in two sections 7 and 8 feet long. Less than 40 percent scaling deduction.



A 10-foot log 16 inches in diameter at the small end. More than 5/6 of its grading-face length is clear in one section 8 feet long. Less than 15 percent deduction for sweep; total deduction is less than 40 percent.



A 12-foot log 20 inches in diameter at the small end. Five-sixths of its grading-face length is clear in two sections 8 and 3 feet long. Scaling deduction is less than 40 percent.

A 16-foot log 20 inches in diameter at the small end. Ten percent deduction for 4 inches of absolute sweep and 5 percent for center rot is less than the 40 percent maximum permitted. Rot is confined to permissible rot zone and does not affect clear grading face.

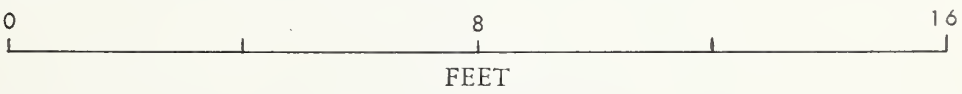
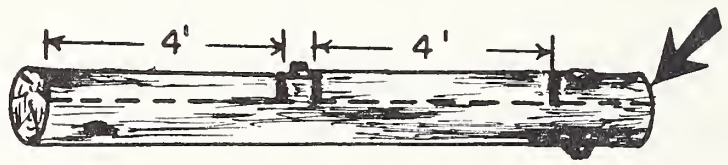


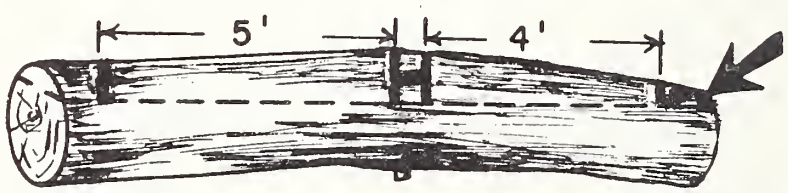
Figure 6.—Examples of hardwood factory grade 1 logs.

HARDWOOD FACTORY GRADE 2



A 10-foot log 11 inches in diameter at the small end. More than ⅔ of its grading-face length is clear in two sections each 4 feet long. Less than 50 percent scaling deduction.

A 9-foot log 12 inches in diameter at the small end. More than ¾ of its grading-face length is clear in two sections 4 and 3 feet long. Less than 50 percent scaling deduction.

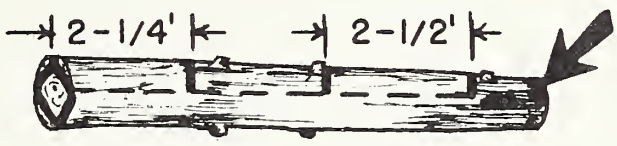


An 11-foot log 18 inches in diameter at the small end. More than ⅔ of its grading-face length is clear in two sections 5 and 4 feet long and deduction of 30 percent for 7 inches of sweep in this sound log is about equal to the maximum permitted.

A 16-foot log 22 inches in diameter at the small end. Nine percent deduction for 4 inches of sweep and 20 percent deduction for rot is less than the 50 percent maximum permitted. Rot limits cutting on grading face, but clear cuttings of 4, 3, and 4 feet give more than the required ⅔ of grading face length.

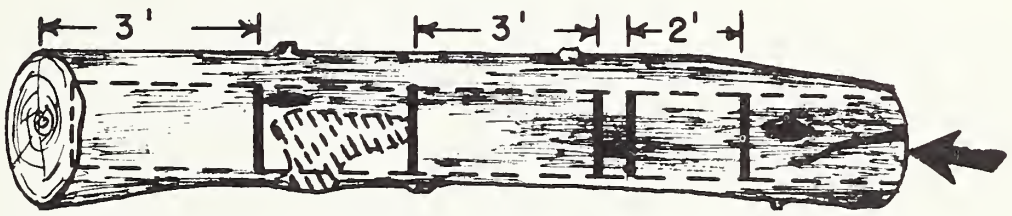
Figure 7.—Examples of hardwood factory grade 2 logs.

HARDWOOD FACTORY GRADE 3

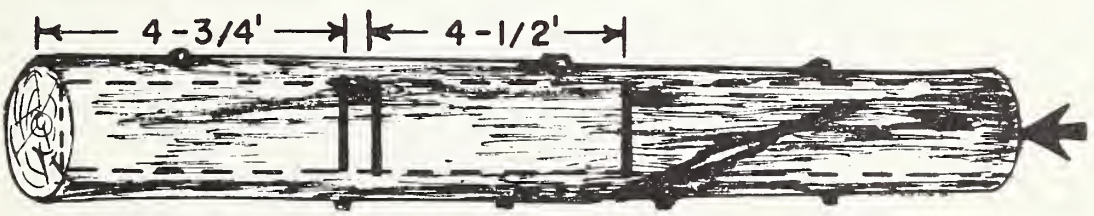


An 8-foot log 8 inches in diameter at the small end. More than ½ of its grading-face length is clear in two sections of 2 feet or longer. Less than 50 percent deduction for rot and sweep.

A 12-foot log 14 inches in diameter at the small end. Interior rot outside the rot zone limits cuttings. However, more than ½ of its grading face is clear in two sections, four and three feet long. No sweep; 15 percent deduction for rot is within the 50 percent maximum permitted.



A 14-foot log 22 inches in diameter at the small end. More than ½ of its grading face length is clear in three sections 3, 3, 2 feet long. Less than 50 percent deduction for sweep and rot.



A 16-foot log 22 inches in diameter at the small end. One-half its grading face length is clear in two sections at least two feet long. Less than 50 percent deduction for sweep and rot.

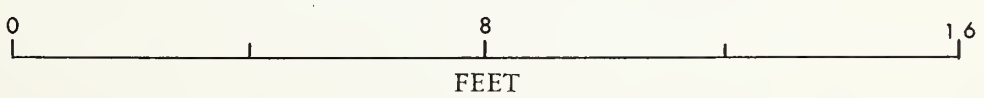


Figure 8.—Examples of hardwood factory grade 3 logs.

Table 2.—Average lumber grade yields for factory lumber logs of selected species, in percent

(From Forest Products Laboratory Report D1737)

Log grade	Lumber grade								Lumber value: July 1961 average [1]
	FAS	SEL	IC	IC & better	2C	3AC	3BC	3C	
				BASSWOOD					
Grade 1	34	9	29	72	17	--	--	11	$143
Grade 2	10	5	37	52	32	--	--	16	113
Grade 3	1	2	27	30	47	--	--	23	91
				YELLOW BIRCH					
Grade 1	36	7	27	70	11	4	15	--	$207
Grade 2	8	5	30	43	21	7	29	--	131
Grade 3	1	1	12	14	19	7	60	--	78
				HARD MAPLE					
Grade 1	25	13	30	68	12	5	15	--	$157
Grade 2	6	6	29	41	21	8	30	--	109
Grade 3	--	1	14	15	25	13	47	--	74
				RED OAK, UPLAND					
Grade 1	35	8	29	72	11	5	12	--	$148
Grade 2	8	4	32	44	20	9	27	--	103
Grade 3	1	1	17	19	24	12	45	--	75
				BEECH					
Grade 1	25	5	37	67	13	5	15	--	$109
Grade 2	8	4	35	47	20	7	26	--	90
Grade 3	1	1	17	19	26	12	43	--	69

[1] Hardwood Market Report, Memphis, Tenn.; (northern hardwoods, 4/4 thickness).

determination is based on the other three faces. Actually, the poorest of the three best faces determines the grade, everything else being equal.

The major problem in grading factory-lumber logs is to locate clear cuttings. To do this requires the proper evaluation of surface defects or abnormalities of any kind. Branch stubs are clearly evident, so they present no problem. But the grader usually needs some training and experience to be able to accurately detect and evaluate other less obvious indications of unclearness (table 1).

Once the surface has been graded, other less visible factors that limit clear cuttings must be evaluated. Often these do not show on the surface. They include hidden interior defects and unsound portions of the log. Such defects are usually evident on

the ends of logs. To allow for them, restrictions are made with respect to maximum allowable scale deduction and size and location of sound end defects such as mineral stain. Minimum diameter, minimum length, maximum allowable sweep, and position of the log in the tree are also important grading factors. Illustrated examples of the three factory-lumber log grades are shown in figures 6, 7, and 8.

Lumber grade yields will vary somewhat by species and diameter within log grades. The yield of No. 1 Common and Better lumber from factory grade 1 logs will range from 65 to 80 percent; from factory grade 2 logs from 40 to 64 percent; and from factory grade 3 logs from 13 to 36 percent. Table 2 shows average grade yields by log grade for several common hardwood species. Detailed grade-yield information is available in U. S. Forest Products Laboratory Report D-1737.

SPECIAL INSTRUCTIONS FOR FACTORY LOGS[1]

Surface Features

1. Superficiality.—A surface abnormality may or may not indicate a blemish, or may not be a defect according to whether or not it is classed as superficial or deep. The zone in which such abnormalities are not considered as grading defects is a zone starting at the surface and extending into the log for a distance 1/5 the diameter at the point of occurrence.

2. Evaluation of defects.—All log surface abnormalities judged to be defects are equal in effect, with the following exceptions in factory logs only:

a. Epicormic or adventitious bud clusters:
   (1) Large (more than 3/8 inch diameter): Full defect on logs of all sizes, grades, and species.
   (2) Small (3/8 inch diameter or less):
      (a) All grades—hard hardwoods[2]
      On logs less than 14 inches: Full defect.
      On logs 14 inches and more: 1/2 defect; i.e., skip every other one.

[1] Based on U.S. Forest Products Laboratory Report D-1737.

[2] Species included: sugar maple, beech, yellow birch, black cherry, sycamore, hackberry, all oaks and ashes, and hickories.

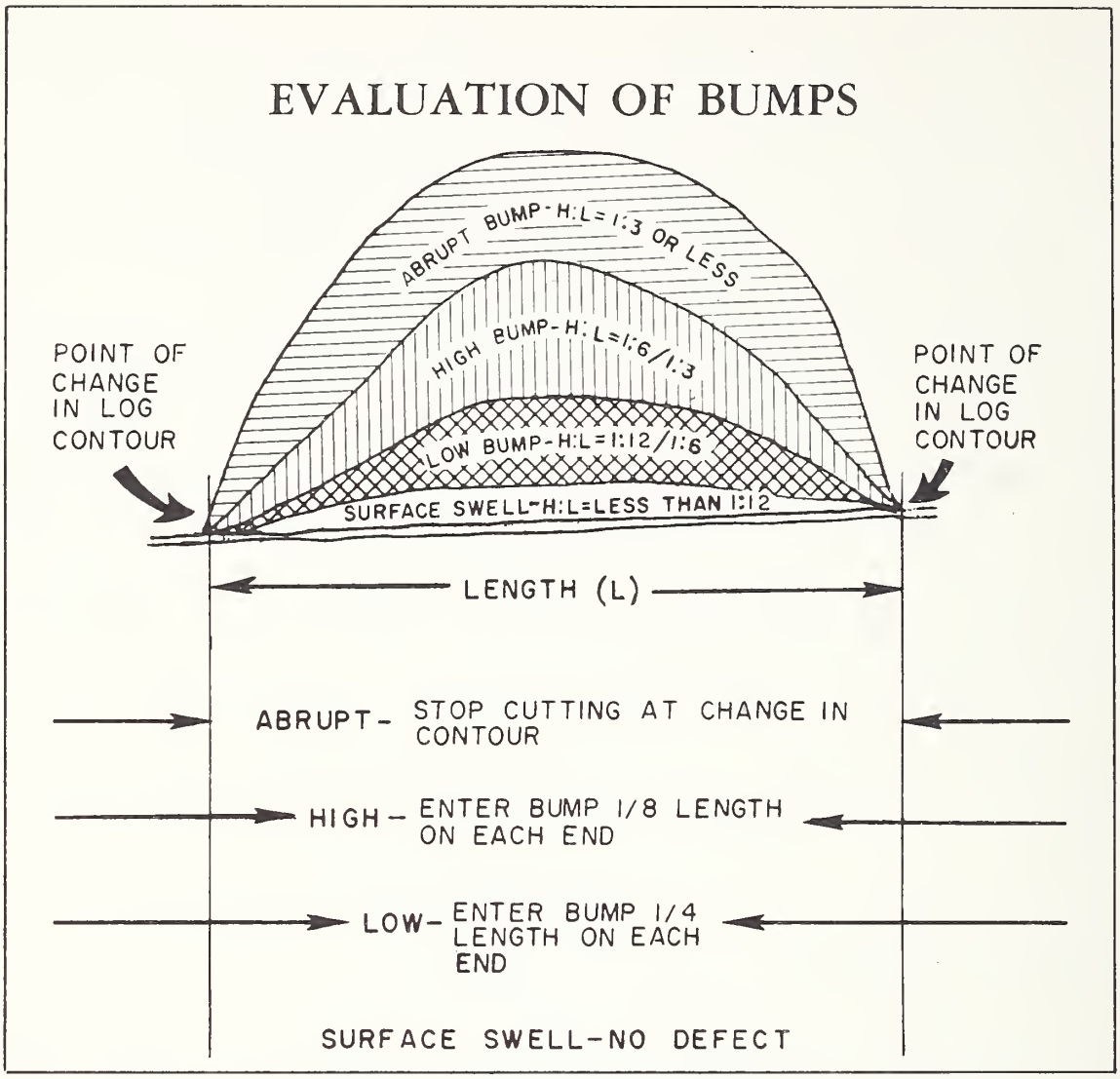


Figure 9.—Evaluation of bumps in hardwood factory lumber logs.

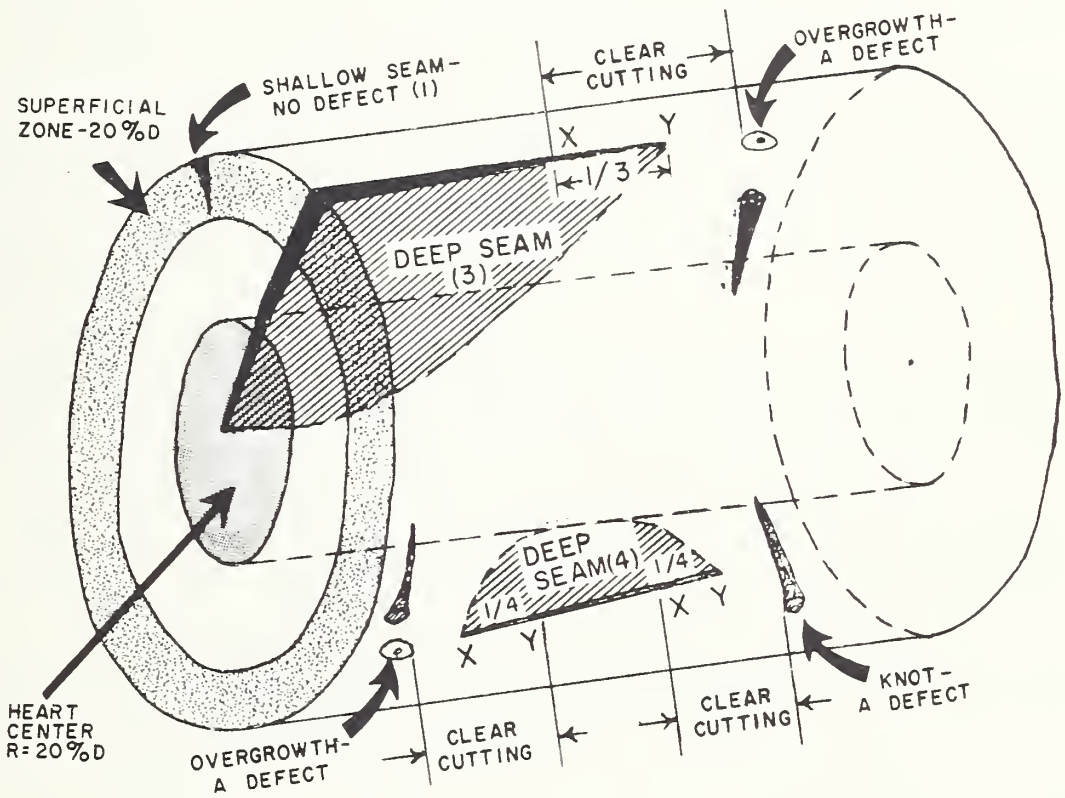
(b) All grades—soft hardwoods[3]
Grades 1 and 2: A full defect on logs less than 14 inches; ½ defect on logs more than 14 inches.
Grade 3: No defect.

b. Grub holes and grub-caused overgrowths:
(1) Progressive on face.
(a) On logs 8-15 inches: each is a full defect.
(b) On logs 16-19 inches: disregard every 6th one.
(c) Logs 20-23 inches: disregard every 5th one.
(d) On logs 24-27 inches: disregard every 4th one.
(e) On logs 28 inches or more: disregard every 3rd one.

[3] Species included: soft maples, basswood, yellow-poplar, gum, magnolia willow, cottonwood, and elm.

EVALUATION OF SEAMS

1. A seam, frost crack, split, etc. is not a defect unless it is deeper than 20% of log diameter.
2. No clear cuttings can be taken on a log face that includes a full-length straight seam or a spiral seam. However, one straight seam can be placed on the edge of one face and ignored. This fixes the location of all other defects.



3. A deep seam entering a face but not running full length may be overlaid with a clear cutting for one-third of its length (x-y), starting at the inner end.
4. When a deep seam is entirely within a log, clear cuttings can be laid over it from each end for a distance equal to one-fourth (x-y) its full length.

Figure 10.—Evaluation of seams, frost cracks, splits, etc., in hardwood factory lumber logs.

(2) Non-progressive—horizontally aligned on face.
(a) When two or more of these defects are found in a band not more than 6 inches wide across the width of the face they may be considered as one.

c. Bumps: Bumps must be considered on all logs, although in some species low bumps can sometimes be disregarded. However when bumps are to be log defects, measurements of length affecting clear cuttings (fig. 9) can vary as follows:
(1) Abrupt bump (length less than 3 times height: example—6 inches long and 4 inches high). Stop clear cutting at change in contour. Do not enter bump with clear cuttings.
(2) Medium bump (length 3 to 6 times height: example—12 inches long and 2 to 4 inches high). Let clear cutting enter bump 1/8 the length on each side.
(3) Low bump (length 6 to 12 times height: example—12 inches long and 1 to 2 inches high). Let clear cutting enter bump 1/4 the length on each side.
(4) Surface rise (length more than 12 times height). Disregard it.

d. Straight seams, frost cracks, splits (fig. 10), not superficial:
(1) Straight seams extending full or part length of the log that can be considered as a line dividing two grading faces can be disregarded.
(2) Straight seams not confinable to lines dividing grading faces:
(a) When full length of log: a full defect.
(b) When extending from one end of log towards middle: include 1/3 length on interior end in the clear cutting.
(c) When completely in log: extend cuttings 1/4 length from each end.

e. Spiral seams, frost cracks, and splits, not superficial: stop clear cutting where defect enters face being graded.

f. Bird peck. Individual pecks are not counted; length of pecked area is measured. A pecked area is one containing four or more pecks per square foot.
(1) Lightly pecked area (fewer than 4 pecks per square foot): Disregard it.
(2) In otherwise No. 3 logs. Disregard all pecked areas.
(3) In logs otherwise No. 1 and No. 2, with heavily pecked areas (more than 4 pecks per square foot).
(a) If pecks are open, disregard.

(b) If pecks are partially or completely occluded, the pecked area is a defect. (Note: age of peck does not matter; test is whether callus tissue is formed in the peck-holes.)

End Features

1. Definitions
   a. Heart center. When heart center is not definitely indicated by exposed knots or concentration of other defects, it is considered to be a central core with pith as center, and radius equal to 1/5 of diameter (fig. 11).
   b. Peripheral zone. The portion of the log outside the heart center.
   c. Affected area. This is defined as the area in which there are blemishes within 3 inches of each other, or the heart center The total affected area and not the blemishes themselves is what is considered in evaluating the degrading effect.

2. Evaluation
   a. Regardless of type, when confined to heart center, all can be disregarded in grading. However, make scale deductions where required.
   b. When defect is not confined to heart center, divide the log end into quarters conforming to the grading faces and evaluate as follows:
      (1) Rot and ring shake (fig. 12). If these enter the peripheral zone in any quarter outside the heart center for a distance that is:
         (a) Less than ½ the width of the peripheral zone, make scale deductions as usual, but disregard as a log defect.
         (b) More than ½ the width of the peripheral zone, make scale deductions as usual but consider as a defect in the quarter and face involved, as follows:
            (i) If it extends full length of log, no clear cutting can be taken.
            (ii) If it extends only partially through the log, allow cuttings to be measured back toward the log end 1/3 the length of the affected area from the point where it is estimated that the rot or shake tapers out.

EVALUATION OF END FEATURES

NOTE: This is the small end of log. It represents the top of the milling frustum. The bottom of milling frustum is D + 2 inches (for 16-foot log). Therefore, in evaluating defects on large end, D + 2 should be used as basis for size of internal cylinder, and superficial zones etc. start at D + 2, with depth calculated on that basis.

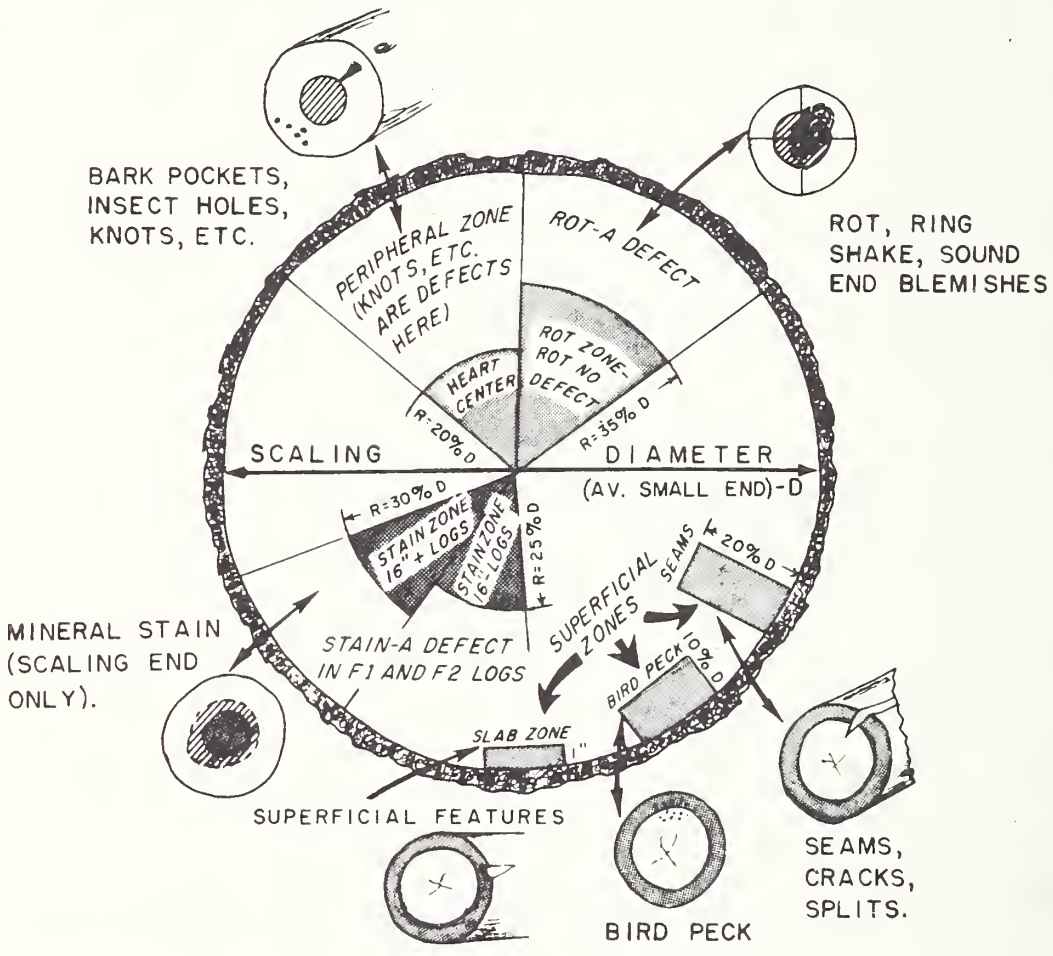
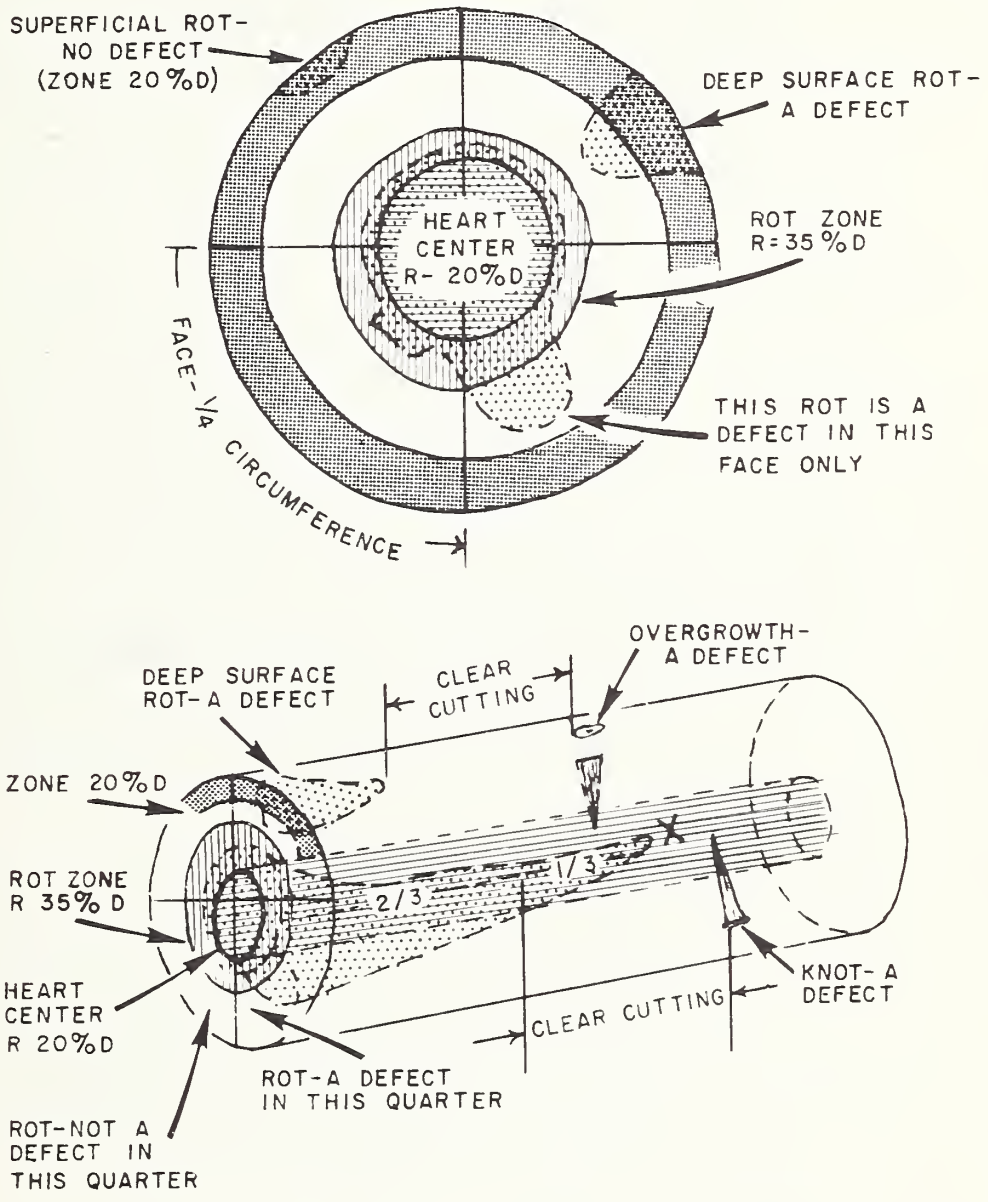


Figure 11.—Relation of end features in hardwood factory lumber logs.

EVALUATION OF ROT AND SHAKE IN HARDWOOD FACTORY LOGS

NOTE: Although scale deduction is made to cover unsound material, area affected may still be a defect.



To evaluate: Estimate point at which rot tapers out (X); then run cutting ⅓ distance to end of log. If rot does not taper into heart center, no clear cutting can be taken.

Figure 12.—Evaluation of rot, shake, and sound end blemishes in harwood factory lumber logs.

(2) Spot worm holes, shot worm holes, pin worm holes, bird peck, bark pockets, grub holes, mineral streak and spot, gum spots, grease spots. When enough of these are found to constitute an affected area in the peripheral zone and the radial measurement of this affected area is:
   (a) Greater than ½ the radius of the peripheral zone in three or four quarters on one end, or two, three, or four quarters on both ends.
      (i) When logs are otherwise F1 or F2, degrade one grade.
      (ii) When logs are otherwise F3, disregard.
   (b) When radial width of affected areas is less than half of peripheral zone, disregard.

(3) Mineral stain and incipient rot. These are considered on the scaling end only; disregard if on the large end only. The affected area in this case is the total area involved, *including* the heart center. When mineral stain or incipient rot occurs in several solid areas that are not joined, the extent is the sum of the individual areas. Treat as follows:
   (a) In logs otherwise No. 1:
      (i) If diameter on scaling end is less than ½ the scaling log diameter, disregard.
      (ii) If diameter on scaling end is more, drop to No. 2.
   (b) For logs otherwise No. 2:
      (i) Logs under 16 inches—if diameter on scaling end is less than ½ of scaling log diameter, disregard; if more, drop to No. 3.
      (ii) Logs over 16 inches—if diameter on scaling end is less than 3/5 of scaling log diameter, disregard; if more, drop to No. 3.
      (iii) For logs otherwise No. 3—disregard.

Grading Factory-Log Faces

1. Standard procedure.—The Forest Products Laboratory Factory Lumber Log Grade Specifications call for grades established on the basis of the three best faces. Sometimes this means grading all four faces; sometimes it does not. After taking into account the size and soundness of the log, the first step in grading is to visually square the log full length into four faces so oriented as to give the largest number of good faces.

Ostrander, M. D., and others.
1963. A Guide to Hardwood Log Grading.
U. S. Forest Serv. Northeast. Forest Expt. Sta.
50 pp., illus. Upper Darby, Pa.

A handbook developed primarily as a teaching aid and field reference in grading hardwood logs. Outlines basic principles and gives detailed practical applications in grading logs and cruising timber. Includes standards for various use classes.

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GRADING BY 3 VISIBLE FACES RELATED TO OFFICIAL GRADING BY 3 BEST FACES

Numbers refer to minimum grade cutting characteristics of each face. Letter x refers to faces that cannot meet minimum specifications for factory No. 3.

Combinations on 3 visible faces	Fourth face possibility	Grade based on poorest of 3 visible faces	Official grade based on 4th face possibilities
1 - 1 - 1	1 2 3 x	1	0 0 0 0
1 - 1 - 2	1 2 3 x	2	1 0 0 0
1 - 1 - 3	1 2 3 x	3	1 2 0 0
1 - 1 - x	1 2 3 x	x	1 2 3 0
2 - 2 - 1	1 2 3 x	2	0 0 0 0
2 - 2 - 2	1 2 3 x	2	0 0 0 0
2 - 2 - 3	1 2 3 x	3	2 2 0 0
2 - 2 - x	1 2 3 x	x	2 2 3 0
3 - 3 - 1	1 2 3 x	3	0 0 0 0
3 - 3 - 2	1 2 3 x	3	0 0 0 0
3 - 3 - 3	1 2 3 x	3	0 0 0 0
3 - 3 - x	1 2 3 x	x	3 3 3 0
x - x - 1	1 2 3 x	x	0 0 0 0
x - x - 2	1 2 3 x	x	0 0 0 0
x - x - 3	1 2 3 x	x	0 0 0 0
x - x - x	1 2 3 x	x	0 0 0 0
1 - 2 - 3	1 2 3 x	3	2 2 0 0
1 - 2 - x	1 2 3 x	x	2 2 3 0
1 - 3 - x	1 2 3 x	x	3 3 3 0
2 - 3 - x	1 2 3 x	x	3 3 3 0

0 0 0 0 — Same grade as official grade.

— 3 visible face grade accurate.

— 3 visible face grade chancy.

— 3 visible face grade uncertain.

Figure 13.—Relationship in factory logs between grading officially by 3 best faces and grading by 3 visible faces.

a. When two X[4] faces are found at once, there is no need to look further, for log is not a factory log.

b. When three *grade faces*[5] are found that are equal, or when two are equal and one is better, grade is determined by the poorest of these faces. For example, 3-3-3 is a No. 3 log; 2-2-1 is a No. 2 log.

c. When three faces are not equal to above, but do not contain an X face (i.e., all are grade faces), then the chances are about equal that the grade based on the poorest of the 3 will be correct. In other cases (2 out of 4) the grade so determined will be one grade lower than actual. For example, 1-2-3 gives No. 3 in 2 cases, and a No. 2 in 2 cases. The grade so determined could be accepted when low-value species are involved and there is no

[4] An X face is one that does not meet minimum cutting specifications for a No. 3 factory log.

[5] A *grade face* is one that meets or exceeds the minimum specifications for a No. 3 factory log face; that is a No. 1 face, No. 2 face or No. 3 face.

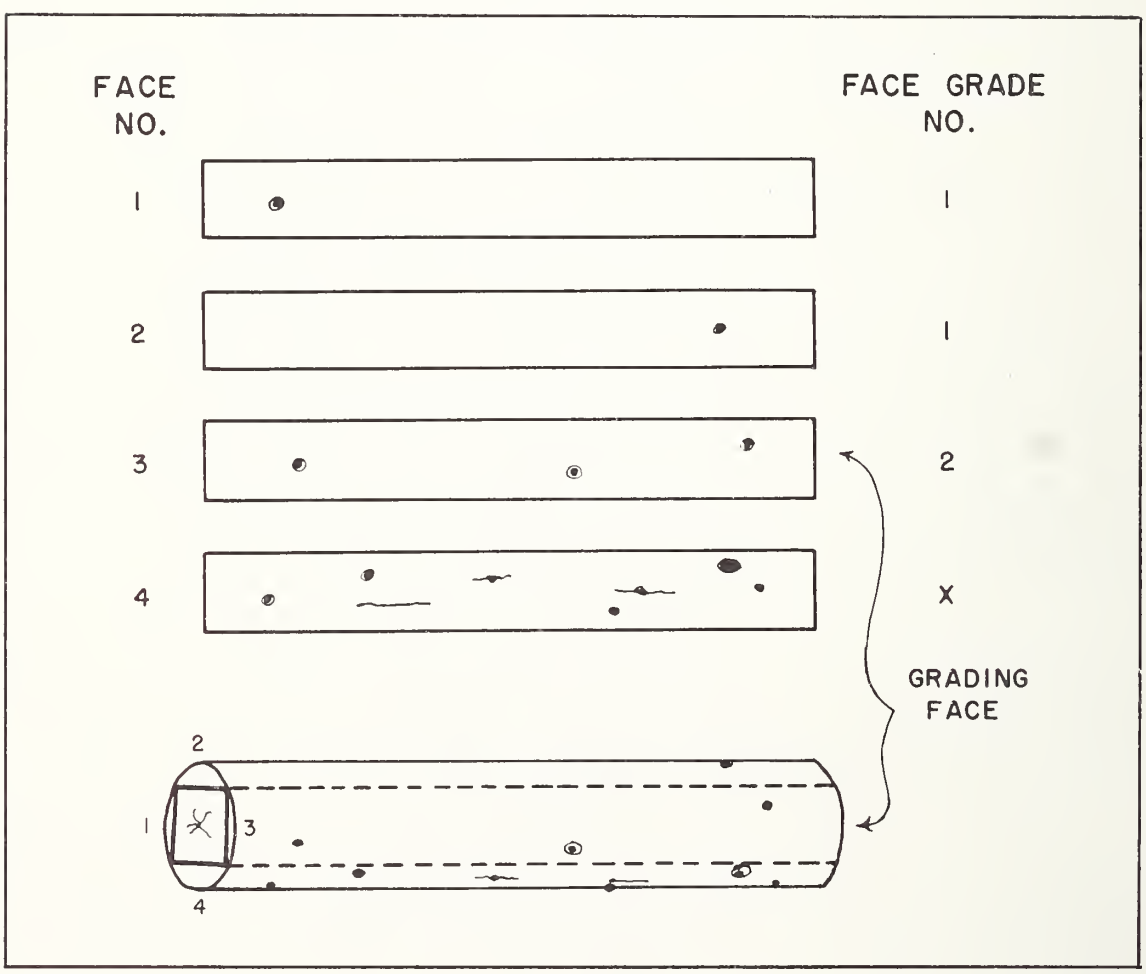


Figure 14.—How to pick the grading face—second poorest. On this basis this log is graded No. 2.

chance of making a No. 1. But if the faces were 1-1-3, the log would be graded as a No. 3; yet there would be a chance that it could be a No. 1, and one that it could be a No. 2. If there is a chance of a No. 1, when high-value species or large logs are involved, then the fourth face should be inspected.

d. If in three faces an X face shows up, it is necessary to examine the fourth face, for on the three-face basis the log will be disqualified as a factory log; but the chances are 3 to 1 that the fourth face will permit it to stay in the class (fig. 13).

2. The grading-face method.—Another approach to expeditious face grading is the *grading-face* concept. As noted, the specifications call for the inspection and grading of all four faces of a log, and the control of the grading rests in the character of the three best faces, other things being equal. Since each of the three best faces must be equal to the minimum requirement for a specific grade, and since rarely are all of the three best faces of the same character, it follows that the poorest of the three best faces is the controlling face (fig. 14). In practice, therefore, it is possible for a trained grader to pick out the controlling or grading face by a quick inspection only, and make the necessary measurements on this.

CONSTRUCTION-LOG CLASS (TIES AND HEAVY TIMBERS)

This class has not been broken down into grades (fig. 15). The major factors that affect the quality of this class of log are size and condition of log defects, straightness, and soundness of heart (table 1). Many logs that fall into this class do not meet the requirements for the factory-lumber class. However, they are well suited for ties and heavy structural timbers. Sound, straight, small-knotted factory-lumber logs will also meet these specifications.

As mentioned previously, there are times when it is good business to produce structural material from the lower grade factory logs that meet structural-log requirements. Such a practice will hold up the percentage of No. 2 Common and Better lumber in the remaining factory-lumber logs. Examples of typical structural-class logs are presented in figure 16.

For grading purposes it is considered that the log contains a square timber, dimensions of which are governed by the small end. Allowed depth of holes is 5 inches from log surface. Table 3 shows allowable knot size (¼ width of face) for the largest squared timber obtainable by log diameters; log knot size (1/3

FOREST SERVICE STANDARD SPECIFICATIONS FOR HARDWOOD CONSTRUCTION LOGS

Note: These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only non-factory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, then it may be necessary to subdivide the class into grades.

Position in tree		Butt & Upper
Diameter, small end		8 inches +
Length, without trim		8 feet
Clear cuttings		No requirements.
Sweep allowance, absolute		1/4 diameter small end for each 8 feet of length.
Sound surface defects	Single knots	Any number, if no one knot has an average collar diameter in excess of 1/3 of log diameter at point of occurrence.
	Whorled knots	Any number if sum of collar diameters does not exceed 1/3 of log diameter at point of occurrence.
	Holes	Any number provided none has a diameter over 1/3 of log diameter at point of occurrence, and none extends over 3 inches into included timber. [1]
Unsound surface defects		Same requirement as for sound defects if they extend into included timber. [1] No limit if they do not.
End defects	Sound	No requirements.
	Unsound	None allowed; must be sound internally, will admit 1 shake not more than 1/3 width of a split 5 inches long (maximum) in contained timber.

[1] Included timber is always square, and dimension is judged from small end.

Figure 15.—Hardwood timber-grading specifications for construction logs.

HARDWOOD CONSTRUCTION LOGS

A 10-foot log 18 inches in diameter at the small end. The cuttings on at least two of the four faces are not equal to the minimum required for factory grade 3. Although it has numerous knots, none has a knot collar exceeding ⅓ of the log diameter at the point where it occurs. The log contains no rot, shake, or splits, and it is straight.

A 12-foot log, 22 inches in diameter at the small end. The cuttings on at least two of the four faces are not equal to the minimum required for a factory grade 3. The numerous knots are small and, although the log is sweepy, the actual sweep does not exceed ¼ of the diameter of the small end of the log. There is no rot, shake, or split.

Figure 16.—Examples of hardwood construction lumber logs.

log diameter at point of occurrence) for corresponding log; maximum sweep allowed per 8 feet of length; and the largest timbers obtainable from a given log, including squared and other commonly stocked dimension timbers.

Larger knots could be allowed where dimension timbers other than squares are to be made, but no knot diameter can exceed ¼ of the width of the face of the tie or timber on which it occurs. Where it is definite that logs are to be used for ties, allowable log knot size can be increased to ½ log diameter at point of occurrence when it is outside a zone between 11 and 13 inches from either

end. This exception cannot be applied to standing timber.

Table 3 will also be helpful in estimating products obtainable from construction logs, and in relating log character to products.

MISCELLANEOUS OR LOCAL-USE CLASS

This class includes the droppings from the previous classes down to the defined *poorest log.* Although this poorest log may vary with species, locality, and economic conditions, its definition is essential as an end point. The standard minimum log as suggested by the Forest Service system is defined in the specifications for miscellaneous or local-use class logs (fig. 17). Examples are presented in figure 18.

Table 3.—Relationship of log diameter to maximum timber sizes and allowable knot size, in inches

Log d.i.b. small end (inches)	Average diameter of largest knot allowed on log surface		Maximum sweep or crook per 8 feet (absolute)	Largest timber obtainable (rough, green)				
				Squared		Common dimension		
	Largest squared timber	Log		To nearest $\frac{1}{4}$ inch	To nearest inch			
6	1-1/16	2	1-1/2	4-1/4	4x4	--	--	--
7	1-1/4	2-1/3	1-3/4	5	[0] 5x5	4x6	--	--
8	1-7/16	2-2/3	2	5-3/4	[1] 6x6	--	--	--
9	1-5/8	3	2-1/4	*6-1/2	6x6	4x8	[2] 6x7	--
10	1-3/4	3-1/3	2-1/2	7	7x7	[3] 6x8	--	--
11	1-15/16	3-2/3	2-3/4	7-3/4	8x8	4x10	[4] 7x8	[5] 7x9
12	2-1/8	4	3	*8-1/2	8x8	6x10	[6] 7x10	--
13	2-5/16	4-1/3	3-1/4	9-1/4	9x9	8x10	--	--
14	2-1/2	4-2/3	3-1/2	10	10x10	8x12	--	--
15	2-5/8	5	3-3/4	10-3/4	11x11	9x12	--	--
16	2-13/16	5-1/3	4	11-1/4	11x11	6x15	8x14	10x12
17	3	5-2/3	4-1/4	12	12x12	7x16	8x15	9x14
18	3-3/16	6	4-1/2	12-3/4	13x13	8x16	12x14	--
19	3-3/8	6-1/3	4-3/4	13-1/2	13x13	10x14	6x16	--
20	3-9/16	6-2/3	5	14-1/4	14x14	12x16	--	--
22	3-7/8	7-1/3	5-1/2	*15-1/2	15x15	12x18	14x16	--
24	4-1/4	8	6	17	17x17	14x20	16x18	--
26	4-5/8	8-2/3	6-1/2	*18-1/2	18x18	14x22	16x20	--
28	4-15/16	9-1/3	7	19-3/4	20x20	14x24	18x22	--
30	5-1/4	10	7-1/2	21-1/4	21x21	14x26	16x24	--
32	5-11/16	10-2/3	8	22-3/4	23x23	16x28	18x26	--

[0] Class 0 cross-tie.
[1] Class 1 cross-tie.
[2] Class 2 cross-tie.
[3] Class 3 cross-tie.
[4] Class 4 cross-tie.
[5] Class 5 cross-tie.
[6] Class 6 cross-tie.

*1/2-inch variation allowed for mismanufacture; i.e., 15-1/2 = 15 x 15 or 16 x 16.

SUGGESTED SPECIFICATIONS FOR HARDWOOD LOCAL-USE LOGS

Position in tree		Butt and upper
Diameter, small end		8 inches +
Length, without trim		8 feet +
Sweep allowance, absolute		1/2 diameter of small end
Total scale deduction allowed		50 to 67%
Clear cuttings		No requirements
Surface defects	Sound	Only requirement is that diameter of knots, holes, rot, etc., shall not exceed 1/2 diameter of log at point of occurrence.
	Unsound	
Sound end defects		No requirements

Figure 17.—Hardwood timber-grading specifications for local-use logs.

VENEER-LOG CLASS

At present there is no uniform Forest Service veneer-log grading system. Studies have now been completed that attempt to evaluate the factors that influence the quality of veneer yield logs, but actual standard grade specifications are still lacking. However, there are numerous local veneer-grade specifications in use, including those published by the Northern Hardwood and Pine Association (fig. 19) and the American Walnut Association. Generally these systems are based on limited information of factors influencing veneer-log quality and could be improved.

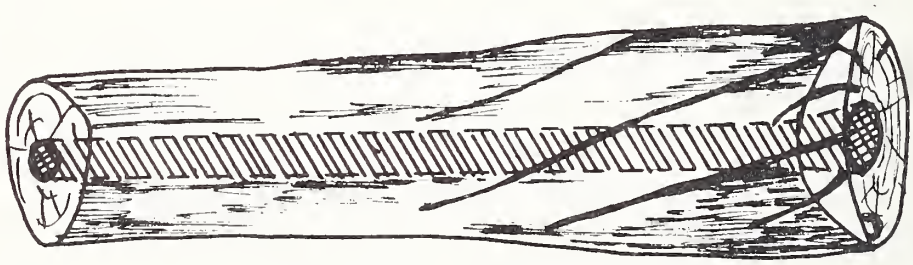
It has been commonly assumed that veneer logs must be of exceptionally high quality. Such an assumption would lead one to believe that only a portion of the higher quality (factory grade 1) sawlogs would qualify as veneer material. Yet comparative analysis of the Forest Service factory-lumber log-grade specifications and the veneer-log specifications of the Northern

LOCAL-USE CLASS

A 14-foot log 16 inches in diameter at the small end. It does not have minimum cuttings required for a factory log. It is too crooked and unsound to meet construction specifications. Sweep and rot deductions are less than 67 percent.

A 12-foot log 18 inches in diameter at the small end. It does not have the cuttings required for a factory log. It has no large knots and no sweep, but it has an unsound heart for which scale deductions will be less than 67 percent.

A 16-foot log 18 inches in diameter at the small end. It does not have the cuttings required for a factory log. Although it is sound, several knots are too large for the construction class.



A 16-foot log 20 inches in diameter at the small end. It does not have the cuttings required for a factory grade 3 log because of the deep spiral seams. It will not qualify as a construction log because of unsound heart.

Figure 18.—Examples of local-use class logs.

NORTHERN HARDWOOD VENEER LOG AND BOLT SPECIFICATIONS

1. Length		6 feet up (plus trim of 4 inches)
2. Diameter, minimum		[1] 12 inches
3. Grain		No spiral grain permitted.
4. Seams	(a)	No spiral seams permitted
	(b)	One straight seam permitted on logs 15 inches and over; none in smaller logs.
5. Sweep	(a)	6- to 9-foot logs: (1) 12-14 inch diameter; no sweep allowed. (2) 15 inch plus diameter: 15% absolute sweep permitted ($A.S. = \frac{S}{D}$)
	(b)	10- to 16-foot logs: No sweep requirement in logs of any diameter (crooks and kinks are defects; see below).
6. Unsound end defect		All sizes: No limitation except all must be confined to a central core the largest diameter of which is not over 1/3 that of scaling diameter.[2]
7. Sound end defect		Black heart or mineral stain in hard maple not to exceed $\frac{1}{2}$ diameter of log at small end.
8. Other log defects, including crook, shake, knots, bird peck, holes, etc.		All diameters: (a) 6- to 7-foot logs: none (must be clear). (b) 8- to 9-foot logs: 1, if not more than 10 inches from an end. (c) 10-foot logs: 1. (d) 12-foot logs: 2. (e) 14-foot to 16-foot logs: 3.

[1] 11-inch logs accepted if 12 feet long or longer and all clear.

[2] Unsound core limited to 6 inches for logs 17 inches and larger, 5 inches for 15-inch and 16-inch logs and 3 inches for logs less than 14 inches in diameter. Diameter of core can be larger if it will reduce to allowable size in 2 feet (in which case 2 feet of length must be deducted from scale).

Figure 19.—Grading specifications for northern hardwood veneer logs and bolts.

Hardwood and Pine Association (fig. 19) show this assumption to be false. Actually a variable portion of all three grades of factory-lumber logs will qualify as veneer under the rules of this association. It should be remembered that the term veneer includes not only fancy or face veneer, but also less valuable veneer suitable for backs and cores of plywood as well as for containers. The latter type of material definitely admits small sound defects that generally are not admissible in the cuttings of factory lumber.

NORTHERN HARDWOOD COMMERCIAL VENEER LOG AND BOLT SPECIFICATIONS

Prepared from Official Grading Rules of the Northern Hardwood and Pine Manufacturers' Association (1947 Edition for No. 1 or Veneer-Grade Logs.)

Grading Factors

1. Diameter: Average, small end, to nearest inch.
2. Length: Feet, with 4-inch trim (ecept that yellow birch and hard maple may be cut 5 feet 6 inches, 6 feet 6 inches, 7 feet 6 inches, 8 feet 6 inches, including trim).
3. Spiral grain: When deviation is more than 1 inch in 10 inches of length.
4. Spiral seam: When deviation is more than 4 inches in length of log.
5. Sweep: Absolute sweep as determined by formula:

$$\frac{\text{Sweep in inches}}{\text{Log diameter in inches}}$$

6. Unsound end defect: Holes, rot, shake.
7. Sound end defect: Black heart and mineral stain.
8. Other log defects: Single abnormalities judged as for factory logs except:
   (a) Superficiality, in butt logs only, is judged on the basis of right cylinder instead of on diameter-depth relation.
   (b) Adventitious buds are not defects.

(c) Log defects are evaluated in 1-foot bands around the log, and not by face system. A single defect may be critical; but other defects located so that they, along with the critical defects, can be cut out in a 1-foot section, are not considered as additional defects.

GENERAL GRADING PROCEDURES

Scaling

Scaling logs is the first step in grading. This not only gives estimate of contents, but gives some of the data needed for applying grade specifications. Scaling should be done carefully, according to standard practices, conforming to those used in developing the grading rules. For hardwood sawlogs these are:

Diameter measurement: Average small end, inside bark.

Length measurement: Longest included full foot.

Scaling deductions:

1. Interior deductions.—There are two widely used methods of making scale deductions for interior defect; these are:

a. By using the squaring system as follows:

$$\frac{(\text{width}'' + 1'') \times (\text{Height}'' + 1'') \times \text{Length}'^{6}}{15}$$

This gives deduction for Scribner Rule; for other rules modify deductions as follows:

	International	*Doyle*
Logs 8-14 inches, multiply by	1.2	0.7
Logs 15-20 inches, multiply by	1.1	0.9
Logs 21+ inches, multiply by	1.0	1.0

b. Also, by using the revised scaling practice developed by Grosenbaugh at the Southern Forest Experiment Station. This system works as follows (rule 5, fig. 8):

(1) Enclose defect in circle or ellipse (say, 7 inches x 9 inches on a 20-inch log).

(2) Measure short and long axis of this in inches and add 1 inch each measurement (8 inches x 10 inches).

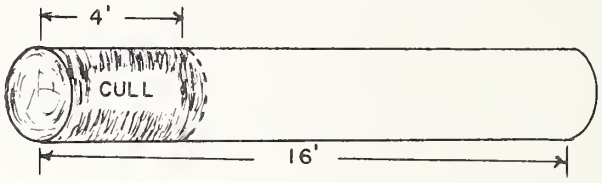
[6] When rot appears on both ends, use average of height and width measurements.

METHODS OF DETERMINING SCALING DEDUCTION

(Examples based on a 16-foot log with 20-inch scaling diameter)

Defect section (rule 1):

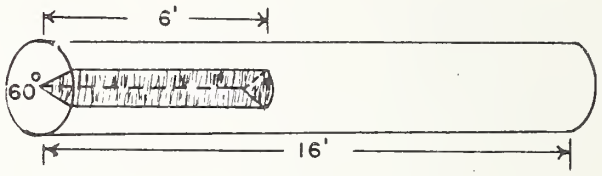
Percent deduction $= \frac{4}{16} = 25\%$



Defect sector (rule 2):

Percent deduction $= \left(\frac{6}{16}\right)\left(\frac{60}{360}\right)$

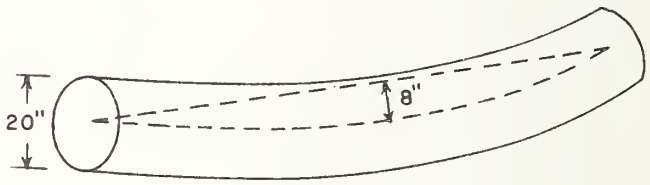
$= 6\frac{1}{4}\%$



Sweep (rule 3):

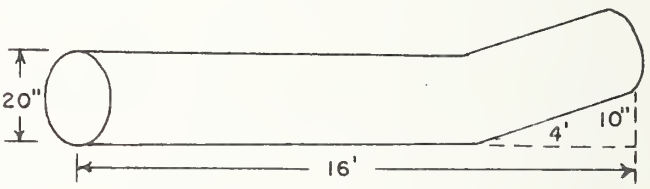
Percent deduction $= \frac{8\text{-}2}{20}$

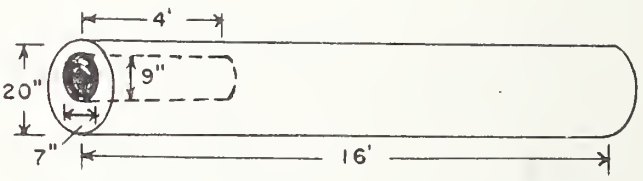
$= 30\%$



Crook (rule 4):

Percent deduction $= \frac{(10)}{20}\,\frac{(4)}{16} = 12\frac{1}{2}\%$





Interior defect (rule 5):

Percent deduction $= \frac{(8)\ (10)}{(20\text{-}1)^2}\left(\frac{4}{16}\right) = 5\text{-}5/9\%$

In practice each ellipse axis can be divided by (20-1) and rounded to nearest tenth if desired.

Thus $\frac{8}{19} = .4$, $\frac{10}{19} = .5$, and $(.4)\ (.5)\left(\frac{4}{16}\right) = 5\%$

Figure 20.—Aids for determining scaling deductions. From: Grosenbaugh, L.R., SHORT CUTS FOR CRUISERS AND SCALERS; U.S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 126, 1952.

(3) Determine, for each augmented length, the percentage this is of log diameter in inches minus 1, and rounding off to nearest 10 percent (8/19 = 40 percent 10/19 = 50 percent).
(4) Determine length of defect as percentage of log length (say, ¼ or 25 percent).
(5) Multiply long axis percent, short axis percent, and length percent together; resulting answer is percent deduction (40 x 50 x 25 = 5 percent).

2. *Other deductions.*—Procedures given in the National Forest Scaling Handbook should be used for making many of these deductions. Grosenbaugh's rules (fig. 20) also cover these.

3. *Deduction for sweep calculated as follows* (rule 3, fig. 20):
   a. Determine actual sweep in inches and subtract 2.
   b. Divide by log diameter; answer is percent deduction for 16-foot log. For 8-foot logs subtract 1 from actual sweep determination and divide by diameter. For intermediate log lengths subtract proportionate amount.

Relation of Scaling Deductions to Log-Grading Defects

In general, it should be understood that making a scaling deduction from the scale of a log up to the limits indicated in the grading rules does not upgrade the log, even though in some cases it may appear that the existence of a rotten heart center, for which scaling deduction is made, would raise the average grade of usable lumber produced. Parts of the portion for which deduction is made may or may not affect clear cutting areas. If they do, they are individual grade defect. This matter is covered in special instructions for factory logs.

The Application of Log Grades in Timber Cruising

In cruising, the estimator under some circumstances may divide the tree bole into logs of variable length that will, in his judgment, be the lengths into which the bole will actually be cut. Under this procedure, each individual log is graded on the basis of its length, diameter, surface, straightness, and estimated scale deduction, with allowance for effect of hidden end defects, based on local studies.

However, when timber is cruised on a graded basis using conventional volume tables, it is necessary that the bole be divided into 16-foot lengths until the top is reached. This bole division may not and generally does not coincide with the way the bole will be bucked in practice. Forest Service studies have shown that bucking to variable lengths to make the best grade logs possible may significantly raise lumber yields over those obtained by this standard-log cruising method.

Consideration must also be given to the presence of interior rot, shake, or insect damage in respect to their effect on log grade. Although there are few published guides to help timber cruisers, the estimation of internal scaling deduction is not an unknown art. To begin with, deductions must be estimated to determine whether or not a log is merchantable, for most merchantability specifications contain, among other things, a provision for maximum scale deduction.

An unsound interior will effectively exclude a log from the construction class, and perhaps from the veneer class. Within the factory class scale deduction limits are broad, although the combined effect of sweep and rot narrows the limits somewhat in crooked logs. Cruisers not accustomed to grading logs in trees sometimes believe it to be impractical because of the requirement that scale deductions must be made. At the same time they overlook the fact that, for adequate volume estimates, similar deductions must be made.

Since the 16-foot evaluation method may understate log quality, the following compensatory procedure is suggested:

1. Divide the bole into 16-foot sections, top section being classed as either a full 16-foot log or an 8-foot halflog, as required by volume table.

2. Grade each full log on a 16-foot length basis. However, if a 12- or 14-foot portion of any 16-foot section will grade better than the 16-foot section in which it is found, then classify the entire 16-foot section on the grade of the best 12- or 14-foot section. This procedure does not change the number of 16-foot logs in the tree. Each 16-foot section is treated separately and discreetly.

3. Top logs are graded on the basis of their actual length; if they are longer than 12-feet the same compensatory procedure applies.

4. As in special cruising, allowances must be made for effect of hidden end defects. These include stain, shake, insect damage, and rot—for which there are no surface indicators. The usual effect of these is to drop No. 1 or No. 2 factory logs a grade, although shake and rot can exclude a log from either factory or construction class.

Appendix

I.
HOW TO USE LOG-GRADE INFORMATION TO DETERMINE VALUES

One of the objects of grading logs is to develop an estimate of the value of the products that can be sawed from the logs under good sawing practice, in a well-maintained mill. The following is a guide to making such value determinations.

For Factory-Lumber Logs

Forest Products Laboratory Report D-1737 shows for each log grade the expectable grade yield outturn. For most species, this is given both as average for all logs in the grade and for individual diameters within the grade. Statistically, the average figure for all diameters is much stronger than the figure for any one diameter, provided one has about the same distribution by diameter as that indicated in FPL Report D-1737. Also shown are values per M, based on average prices as they existed in June 1948. Depending upon the desired accuracy of the value estimate, the following suggestions for determining current values are made.

1. Very rough estimate.—Take average values per M, from tables in FPL Report D-1737.

2. Partially corrected estimate.—With no local data except current lumber prices:

a. Use index such as IC 4/4 and get ratio of June 1948 price to current price as correction for average value in table.

b. Use average yield percentages from table:
   (1) Get weighted 4/4 average as of June 1948 and of current date; correct average value in table by ratio.
   (2) Get average current value based on yields and thicknesses in table: result is the average price corrected for market change.

3. More refined estimate.—When limited local data are available:

a. Get average current value by using average grade yields shown in table and average thicknesses produced from mill run logs.

b. Get average current value by using average grade yields shown in table and average thickness produced from each grade of log. This corrects for market change and actual thickness production.

4. Most refined estimate.—When adequate local data are available:

a. Get average current value by using average thickness produced per grade of log, and grade yields shown in table for:
   (1) Specific diameter of average log per grade.
      (a) Estimated.
      (b) Calculated on basis of squares.
   (2) For each diameter sawed, weighted by volume sawn in each diameter class.

b. Get average current value by using thickness pattern produced from each diameter of log in a grade applied to grade yields for each diameter, weighted by the volume sawed in each diameter class. This corrects for market price, thickness, and log diameter.

For Log Classes Other Than Factory

For structural and local-use logs, no graded product information is available. Values must be developed from individual mill experience. It is suggested that the following sources of lumber price information be consulted:

National Hardwood Magazine, P.O. Box 1721, Memphis, Tenn. Prices of southern appalachian and northern hardwoods, f.o.b. Chicago, are published each month.

Hardwood Market Report, P.O. Box 5716, Memphis 4, Tenn. Prices are published weekly for southern hardwoods, f.o.b. mills Texas and Louisiana area; for appalachian hardwoods, f.o.b. mills Johnson City, Tenn., area; and for northern hardwoods, f.o.b. mills in Wausau, Wisconsin, area.

Commercial Bulletin, Curtis Guild & Co., 144 High Street, Boston 10, Mass. New England hardwood and softwood prices are published weekly.

II
TABLES FOR MAKING INTERIOR SCALE DEDUCTIONS

Based on Grosenbaugh's Rule 5, two working tables of factors for determining scale deduction are presented here:

Table 6.—This table shows a factor that expresses the relation of scaling diameter minus 1 (inches, average of small d.i.b.) and length of scaling defect section (as estimated to the nearest 10 percent of log length). *Use actual diameter, do not take off an inch.*

Table 7.—This table shows factors that evaluate the cross section of the defect area. *Actual long and short dimensions in inches are used; do not add a collar allowance in measuring.*

To find scale deduction:

1. In table 6, find factor for log scaling diameter (inches) and length of scaling defect section (percent of log length), i.e., 18-inch log, scaling defect section 30 percent of length = factor 0.6.
2. In table 7, find factor for short and long dimension of defect cross section (i.e., 5 inches x 7 inches = factor 8).
3. Multiply the two factors to get scale deduction in percent of log scale: 8 x 0.6 = 4.8 percent. Round to nearest percent = 5 percent.

If this seems a cumbersome procedure, consider the sequence. Log length, scaling diameter, and scaling-defect section length can be determined in one operation; cross-section dimensions in another. As the first two (length and diameter) are recorded, the table 6 factor for defect length can be observed and kept in mind. Then, after making measurement of the cross section, the appropriate factor can be located in table 7, and the two factors can be multiplied mentally.

For logs over 25 inches in scaling diameter, use Grosenbaugh's formula.

Where cull area goes completely through the log, use average of dimensions as measured on both ends.

Where defect cross-section can be contained in a square instead of an oval, add ¼ to the values derived.

Table 4.—International decimal ¼-inch log rule

D.i.b. (inches)	Length in feet				
	8	10	12	14	16
6	10	10	10	20	20
7	10	20	20	20	30
8	20	20	30	30	40
9	20	30	40	40	50
10	30	40	50	60	60
11	40	50	60	70	80
12	40	60	70	80	100
13	50	70	80	100	120
14	60	80	100	120	140
15	70	90	110	140	160
16	80	110	130	160	180
17	100	120	150	180	210
18	110	140	170	200	230
19	120	160	190	220	260
20	140	170	210	250	290
21	150	190	230	280	320
22	170	210	260	310	350
23	190	240	280	340	390
24	200	260	310	370	420
25	220	280	340	400	460
26	240	300	370	430	500
27	260	330	400	470	540
28	280	360	430	510	580
29	300	380	460	550	630
30	330	410	500	590	670

Computed from volume of 4-foot section for 1/8" sawkerf = $0.22D^2 - 0.71D$ and on assumed taper of 1/2 inch in 4 feet. Result multiplied by 0.905 to convert to 1/4" sawkerf. Computed by Northeastern Forest Experiment Station, 1951.

Table 5.—Scale deduction aids: sweep deductions based on rule 3

(In percent deduction from gross scale)

Absolute sweep (inches)	Scaling diameter, average small end inside bark, in inches								
	8	10	12	14	16	18	20	22	24
				16-FOOT LOGS[1]					
4	25	20	15	15	10	10	10	10	10
6	50	40	35	30	25	20	20	20	15
8	X	X	50	45	40	35	30	30	25
10	X	X	X	X	50	45	40	35	35
12	X	X	X	X	X	X	50	50	40
14	X	X	X	X	X	X	X	X	50
				8-FOOT LOGS[2]					
2	10	10	10	5	5	5	5	5	5
4	40	30	25	20	20	15	15	15	10
6	X	50	40	35	30	30	25	25	20
8	X	X	X	50	45	40	35	30	30
10	X	X	X	X	X	50	45	40	40
12	X	X	X	X	X	X	X	50	45

X = Over maximum allowance for graded logs.

[1] Basis: $\text{Loss} = \frac{\text{Absolute sweep (inches)} - 2''}{\text{Scaling diameter (inches)}}$

[2] Basis: $\text{Loss} = \frac{\text{Absolute sweep (inches)} - 1''}{\text{Scaling diameter (inches)}}$

Note: for other lengths, sweep deductions can be interpolated from figures given.

Table 6.—Scaling diameter: defect length factors

Scaling diameter (inches)	Percent of log length in cull section									
	10	20	30	40	50	60	70	80	90	100
8	1.2	2.4	3.5	4.7	5.9	7.1	8.2	9.4	10.6	11.8
9	.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.0
10	.7	1.4	2.1	2.8	3.6	4.3	5.0	5.7	6.4	7.1
11	.6	1.1	1.7	2.3	2.9	3.4	4.0	4.6	5.2	5.8
12	.5	1.0	1.4	1.9	2.4	2.9	3.3	3.8	4.3	4.8
13	.4	.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0
14	.3	.7	1.0	1.4	1.7	2.0	2.4	2.7	3.1	3.4
15	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.6	2.9
16	.3	.5	.8	1.0	1.3	1.5	1.8	2.0	2.3	2.6
17	.3	.4	.7	.9	1.1	1.4	1.6	1.8	2.0	2.3
18	.2	.4	.6	.8	1.0	1.2	1.4	1.5	1.8	2.0
19	.2	.4	.5	.7	.9	1.1	1.2	1.4	1.6	1.8
20	.2	.3	.5	.6	.8	1.0	1.1	1.3	1.4	1.6
21	.2	.3	.4	.6	.7	.9	1.0	1.2	1.3	1.4
22	.1	.3	.4	.5	.7	.8	.9	1.0	1.2	1.3
23	.1	.2	.4	.5	.6	.7	.8	1.0	1.1	1.2
24	.1	.2	.3	.4	.5	.6	.8	.9	1.0	1.1
25	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0

Note: Do not take off an inch in measuring diameter.

Table 7.—Interior defect cross-section factors

Short axis inches	Long axis, inches													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	2	2	3	3	4	4	5	5	6	6	7	7	8	8
3	--	3	3	4	5	5	6	7	8	8	9	10	10	11
4	--	--	4	5	6	7	8	9	10	10	11	12	13	14
5	--	--	--	6	7	8	9	10	11	12	14	15	16	17
6	--	--	--	--	8	10	11	12	13	15	16	17	18	19
7	--	--	--	--	--	11	12	14	15	17	18	19	21	22
8	--	--	--	--	--	--	14	16	17	19	20	22	23	25
9	--	--	--	--	--	--	--	17	19	21	23	24	26	28
10	--	--	--	--	--	--	--	--	21	23	25	27	29	31
11	--	--	--	--	--	--	--	--	--	25	27	29	31	33
12	--	--	--	--	--	--	--	--	--	--	29	32	34	36
13	--	--	--	--	--	--	--	--	--	--	--	34	36	39
14	--	--	--	--	--	--	--	--	--	--	--	--	39	42
15	--	--	--	--	--	--	--	--	--	--	--	--	--	44
16	--	--	--	--	--	--	--	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Note: Do not add a collar allowance in measuring axes.

III
TIMBER ESTIMATING AIDS

Table 8.—Percentage of total tree volume in each log (16-foot logs)

Merchantable height, No. of logs	Position of log in tree						
	1	1½	2	2½	3	3½	4
1	100	--	--	--	--	--	--
1½	70	30	--	--	--	--	--
2	55	--	45	--	--	--	--
2½	45	--	40	15	--	--	--
3	40	--	35	--	25	--	--
3½	40	--	30	--	20	10	--
4	35	--	30	--	20	--	15

[1] Approximate average of diameters and form classes.

Table 9.—Average upper-log taper for hardwoods (16-foot logs)

No. logs in tree	Log position	Log taper, by tree diameter class (inches)--	
		12 to 18	20+
		Inches	Inches
2	2	2.0	2.5
3	2	1.5	2.0
	3	2.0	2.5
4	2	1.0	1.5
	3	1.5	2.0
	4	2.0	2.5

Table 10.—Sample of proportionate volume table for individual logs in trees of mixed hardwood species (Girard-Mesavage form class 78, International 1/4-inch rule)

(Volume per log in board feet, International 1/4-inch rule)

D.b.h. class (inches)	Position of log in tree								
	1	1½	2	2½	3	3½	4	4½	5
12	56	18	36	14	28	--	--	--	--
14	78	27	54	21	42	13	--	--	--
16	106	37	74	30	61	22	--	--	--
18	136	48	97	41	81	30	60	--	--
20	171	63	125	52	105	39	79	31	62
22	211	79	157	66	132	52	103	44	88
24	251	95	190	82	164	59	118	59	117
26	299	115	229	98	197	76	152	72	144
28	347	135	269	117	234	88	177	87	174
30	403	157	315	136	273	103	207	108	217

DERIVATION OF PROPORTIONATE VOLUME TABLE

No. logs in tree and volume in tree (Girard-Mesavage form class 78)

	1	1½	2	2½	3	3½	4	--	--
18	136	184	233	274	314	344	374	--	--

Position of logs in tree and volume per log (derived)

18	136	48	97	41	81	30	60	--	--

This space available for identification

Log Grade → / ← Deduction %

Net → / ← Gross

Tree No.	Sp.	D.B.H.	F.C.	Log position (16-foot logs)									Tot. vol.	Vol. by grade				
				1	1½	2	2½	3	3½	4	4½	5		F1	F2	F3	C	LU
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
0																		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
0																		
Tot.																		

Figure 21.—Suggested form for recording tree log-grade data.

Species_____

No.	Length	Scal. dia.	Gross scale	Deductions						Tot. %	Net scale	Grade	Cause* of degrade	Log Pos.	Remarks
				Sw. %	Internal										
					L	W	H	Ft.	%						
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															

*D = Size; L = Log defect; S = Internal scale deduction; E = End defect; C = Crook or sweep; O = Other.

Figure 22.—Suggested form for making graded log tally when analysis is contemplated.

Log No.	Species	Length	Diam.	Deductions (feet)	Net scale by				
					F1	F2	F3	Constr.	Local-use

Net scale summary by species	F1	F2	F3	Constr.	Local-use
Total					

Figure 23.—Suggested forms for making graded log yard tally when analysis is not contemplated.

IV
SELECTED REFERENCES

(1) Flick, Frances J.
1955. GRADING LOGS AND TREES FOR QUALITY; A BIBLIOGRAPHY COMPILED FOR THE LOG GRADE COMMITTEE. U.S. Forest Service, 27 pp. Washington.

(2) Larson, Nellie G.
1959. GRADING LOGS AND TREES FOR QUALITY; A BIBLIOGRAPHY COMPILED FOR THE LOG GRADE COMMITTEE. U.S. Forest Service, 11 pp. Washington.

(3) Lockard, C. R., Putnam, J. A., and Carpenter, R. D.
1950. LOG DEFECTS IN SOUTHERN HARDWOODS. U.S. Dept. Agr. Handbook 4. 37 pp., illus.

(4) National Hardwood Lumber Association.
1951. RULES FOR THE MEASUREMENT AND INSPECTION OF HARDWOOD LUMBER, CYPRESS, VENEERS AND THIN LUMBER. 80 pp., illus. Chicago.

(5) Newport, Carl A., Lockard, C. R., and Vaughn, C. L.
1959. LOG AND TREE GRADING AS A MEANS OF MEASURING QUALITY. National Log Grade Committee, U.S. Forest Service, 31 pp. Washington.

(6) Putnam, John A., Furnival, G. M., and McKnight, J. S.
1960. MANAGEMENT AND INVENTORY OF SOUTHERN HARDWOODS. U.S. Dept. Agr. Handbook 181. 102 pp., illus.

(7) United States Forest Products Laboratory.
1953. HARDWOOD LOG GRADES FOR STANDARD LUMBER. U.S. Forest Prod. Lab. Rpt. D1737, 66 pp., illus.

References 1 and 2 have been published under a single cover entitled GRADING OF LOGS AND TREES FOR QUALITY—BIBLIOGRAPHIES COMPILED FOR THE FOREST SERVICE LOG GRADE COMMITTEE. 50 pp., 1961. A revision of reference 3 is now being prepared for publication.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